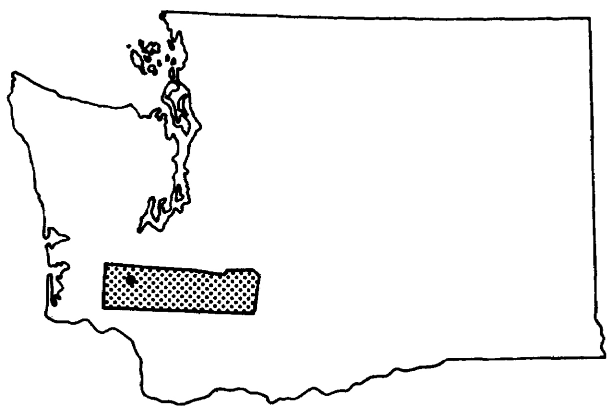
FLOOD INSURANCE STUDY

CITY OF CHEHALIS, WASHINGTON
LEWIS COUNTY



NOVEMBER 1979

FEDERAL EMERGENCY MANAGEMENT AGENCY
FEDERAL INSURANCE ADMINISTRATION

COMMUNITY NUMBER - 530104

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FLOOD INSURANCE STUDY

1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the City of Chehalis, Lewis County, Washington, and to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to convert Chehalis to the regular program of flood insurance by the Federal Insurance Administration. Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain development.

1.2 Coordination

Streams selected for detailed analysis were identified in a meeting attended by representatives of the community, a study contractor formerly identified to perform the study but not subsequently brought under contract, and the Federal Insurance Administration on April 14, 1976. A later meeting was attended by representatives of Lewis County, the finally selected study contractor, and the Federal Insurance Administration on July 6, 1976.

During the course of the work, numerous informal contacts were made by the study contractor with the community for the purpose of obtaining data and acquiring base map material.

On August 7, 1978, the results of the work were reviewed at an interim technical meeting attended by representatives of the study contractor, the Federal Insurance Administration, and the City of Chehalis.

The results of this study were reviewed at a final community coordination meeting held on January 21, 1979. Attending the meeting were representatives of the Federal Insurance Administration, the study contractor, and the city council. No problems were raised at this meeting which would affect the technical results of this study.

1.3 Authority and Acknowledgments

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were performed by Tudor Engineering Company, for the Federal Insurance Administration, under Contract No. H-4025. This work, which was completed in September 1978, covered all significant flooding sources affecting the City of Chehalis.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Chehalis, Lewis County, Washington. The area of study is shown on the Vicinity Map (Figure 1).

Flooding caused by overflow of the Chehalis and Newaukum Rivers and Salzer, Coal, and Dillenbaugh Creeks was studied in detail. All of these streams were studied along their entire length within the corporate limits. However, because there are areas within the city that are flooded by portions of the streams outside the corporate limits, the detailed study limits were extended beyond the city. The study limits are as shown below.

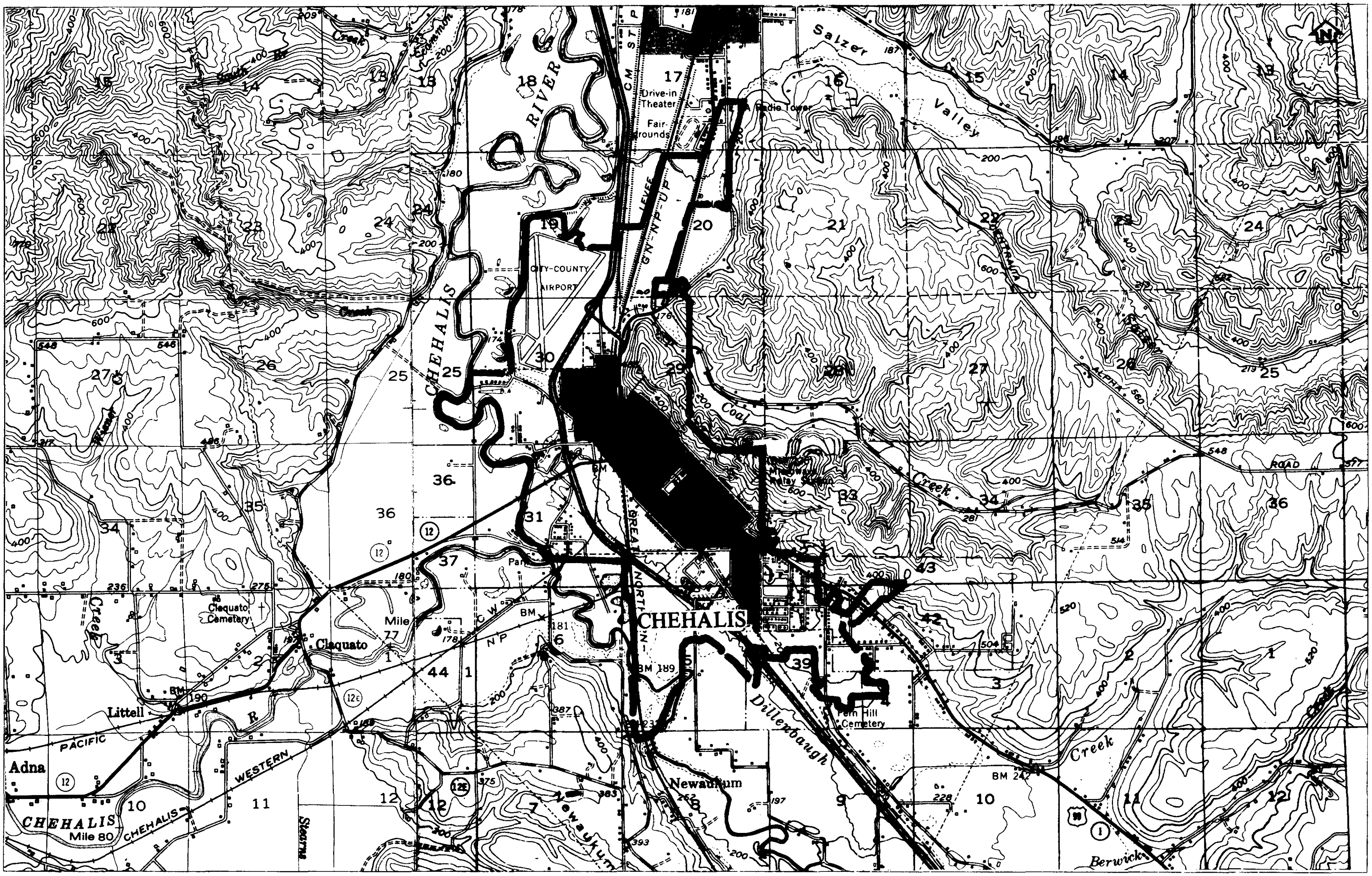
Stream	Study Limits (River Miles)
Chehalis River	60.5 to 97.0
Newaukum River	0.0 to 10.8
Coal Creek	0.0 to 3.8
Salzer Creek	0.0 to 7.6
Dillenbaugh Creek	0.0 to 4.8

Those areas studied by detailed methods were chosen with consideration given to all proposed construction and forecasted development through 1983.

2.2 Community Description

The City of Chehalis is the county seat and is located in northwest Lewis County, in southwest Washington. The city, bordered by the City of Centralia, Lewis County's largest community, to the north and by unincorporated land of Lewis County to the east, south, and west, is 85 miles south of the City of Seattle on Interstate Highway 5 and 85 miles north of the City of Portland. The city lies on the right (east) bank of the Chehalis River, near the mouth of the Newaukum River.

The City of Chehalis' population in 1975 was estimated at 5900 (Reference 1). Settlers came to the area first in 1851. A community was established there in 1858 with the establishment of the Saundersville Post Office, named after the area's first settler, Schuyler S. Saunders, from New York. Following Saunders' death, the community was renamed Chehalis in 1870, an Indian word meaning "shifting and shining sands" (Reference 2). Growth was rapid and led to incorporation of the community in 1883. Population remained less than 2000 until after the turn of the century. Following a surge to a population of 4507 by 1910, Chehalis has grown slowly and steadily to its present size (Reference 3).



DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF CHEHALIS, WA
(LEWIS CO.)

APPROXIMATE SCALE

1 0 1 2 3 MILES

VICINITY MAP

FIGURE 1

Chehalis was the center for a predominantly farming community. Completion of the Northern Pacific Railroad line (now the Burlington Northern Railroad) in 1873 was followed in 1874 by location of the county seat in the city. In 1881, a flour mill was opened, and this was followed by other development. Industrial and commercial activity now includes fruit canning; logging; dairy products and poultry processing; and manufacturing of lumber and wood products, metal castings, prefabricated modular buildings, and tire rubber (References 4 and 5).

Chehalis is located at an elevation of 204 feet, in a 2-mile wide plain through which the Chehalis River flows. The upper portions of the Chehalis and Newaukum River basins are rugged and densely forested, rising to elevations of 5000 feet. South of the City of Chehalis, the river flattens onto a fertile plain, through which it meanders to its outlet to the Pacific Ocean at Grays Harbor. The slope of the Chehalis River from its source to Chehalis is steep, falling an average of 16 feet per mile. Through the study area, the slope is approximately 3 feet per mile. The drainage area of the Chehalis River above its confluence with the Newaukum River is 438 square miles, and that of the Newaukum River is 155 square miles, for a total of 593 square miles (Reference 6).

The Chehalis River flows north, forming the western corporate limits for most of the city's length. The Newaukum River flows northwesterly through the southern portion of Chehalis before emptying into the Chehalis River just below the southwestern corner of the city. Dillenbaugh and Salzer Creeks empty into the Chehalis River, Salzer Creek to the north of Chehalis and Dillenbaugh Creek in the middle of the city. Coal Creek empties into Salzer Creek after flowing north through the city.

Most of the residences and a large part of the business district of Chehalis are located outside the portion of the flood plain subject to inundation by the Chehalis River. However, a considerable area of the city is subject to inundation. This area of the flood plain, located west of Interstate Highway 5, is primarily devoted to agriculture and similar purposes and includes the sewage treatment plant and the Chehalis-Centralia Airport.

The regional climate is predominantly a mid-latitude, west coast marine type. Summers are comparatively cool, and winters are mild, wet, and cloudy. Temperatures occasionally exceed 90°F in the summer and rarely drop below 32°F during the winter. Average annual precipitation is 45 inches at Chehalis, but ranges up to 100 inches on the windward slopes of the Cascade Mountains within the Chehalis River basin. Much of the latter is in the form of snow, with 150 to 300 inches often recorded in the elevation range between 2500 and 4000 feet (References 5 and 7).

2.3 Principal Flood Problems

Major flooding within the Chehalis River basin occurs during the winter season, generally from November through February, and is the result of heavy rainfall, occasionally augmented by snowmelt. In the City of Chehalis, the principal sources of high winter floodflows are the Chehalis and Newaukum Rivers. Much of the flooding along the lower reaches of the Newaukum River is caused by high backwater from the Chehalis River. Secondary sources of flooding are Salzer Creek and Dillenbaugh Creek, tributaries to Chehalis River, and Coal Creek, a tributary to Salzer Creek. The worst flooding would occur when the Chehalis River and its tributaries reach flood stage at the same time. Waters from Chehalis River flood the urban area and, at the same time, back up and prevent the escape of waters from the tributary streams.

Flows recorded for the Chehalis River have been maintained since 1928 at the U.S. Geological Survey gaging station near Grand Mound, 6 miles downstream of Centralia. Flood stage is considered to be 14.5 feet at the gage, corresponding to a flow of approximately 23,000 cubic feet per second. Over a 48-year period of record, flood stage has been exceeded on 38 occasions. Of these, four of the eight largest floods on the Chehalis River have occurred since 1970.

Table 1 lists the highest discharges at the Grand Mound stream gage in 48 years of records (References 6, 8, 9, and 10).

Table 1. Peak Historic Discharges, Chehalis River

Date	Peak Discharges (Cubic Feet per Second)	Gage Height (Feet)	Approximate Recurrence Interval (Years)
January 21, 1972	49,200	18.21	33
December 29, 1937	48,400	18.39	30
December 21, 1933	45,700	18.00	21
December 5, 1975	44,800	17.73	21
January 26, 1971	40,800	17.29	11
January 23, 1935	38,000	17.10	8
February 10, 1951	38,000	16.96	8
January 17, 1974	37,400	16.88	7

High flows at Grand Mound usually coincide with peak flows on the Newaukum River. A gaging station at River Mile 4.4 on the Newaukum River has been in service since March 1929, with the exception of the period from September 1931 to July 1942. The highest flows occurring in 36 years of records are listed in Table 2.

Table 2. Peak Historic Discharges, Newaukum River

Date	Peak Discharges (Cubic Feet per Second)	Gage Height (Feet)	Approximate Recurrence Interval (Years)
January 21, 1972	9770	12.12	29
January 15, 1974	8440	11.17	13
January 26, 1971	8390	11.99	13
December 14, 1975	8020	10.85	9
January 25, 1964	7970	12.97	9
December 9, 1953	7880	13.62	8
January 15, 1976	7560	10.47	7
January 14, 1975	7400	10.33	6
December 12, 1955	7200	13.00	5

Crest stage on the Chehalis and Newaukum Rivers is usually reached within 1 day of the heaviest rainfall, and the peak flow usually subsides within a few hours. In the immediate vicinity of the confluence of the Chehalis and Newaukum Rivers, backwater effects may prolong high river stages for several hours on either river.

The January 1972 flood was the largest recorded flood in the upper Chehalis River basin. The flood was extremely severe near the confluence of the Chehalis and Newaukum Rivers because of the record-high discharges on both rivers and the nearly simultaneous peaking of the two rivers at the confluence. The flood resulted from heavy rains and rapid warming which accompanied an intense maritime Pacific storm system. Other damaging floods occurred in the upper Chehalis River basin during December 1933, January 1935, December 1937, January 1973, and December 1975. These floods are considered to be the largest floods during the period from 1929 to the present (Reference 11).

Photographs of historic flooding in Chehalis are shown in Figures 2 and 3.

Flooding results in disruption of communications and damage to property in the area. Excerpts from descriptions of historical floods follow:

> Between Chehalis and Centralia the water at one time is said to have attained a depth of fully two feet over the newly constructed hard-surface pavement (Reference 12).

> During the disastrous flooding of 1972, more than $819,000 worth of damage was inflicted on public property. Of that total, $400,000 damage was to the Southwest Washington Fairgrounds (Reference 13).

Figure 2. Chehalis River Flood Stage on December 4, 1975, Looking North Towards Airport (Downtown Chehalis Is at Upper Right)

Figure 3. January 26, 1971, Flooding in the Northern Portion of Chehalis, Showing Backwater on Salzer and Coal Creeks Near Confluence With Chehalis River (Airport Shown on Right With Yardbirds Store at Left Center)

The Newaukum and Chehalis Rivers swept over their banks in the Riverside Drive and airport areas. Many residents in the area had to be evacuated (Reference 13).

Employees at Prairie Market, adjacent to Kresky Avenue, pumped water out of the building Thursday morning when raging Salzer Creek went over its banks (Reference 13).

2.4 Flood Protection Measures

The City of Chehalis is under State Flood Plain Management Regulations of the Washington State Flood Control Zone Act of 1935, 1960, and 1969 and the Washington Water Resources Act of 1971, including shoreline management. Under Chapter 86.16 of the Revised Code of Washington, the Chehalis River and its tributaries are in Flood Control Zone 13. Chehalis has no additional building and development regulations related to flood hazards.

Flood control structures that provide low to medium levels of protection have been built by local agencies in coordination with State and Federal agencies. Principal flood control measures in the study area are approximately 1.75 miles of levee on the right bank of the Chehalis River that protect the city-county airport from a 50-year flood event at Chehalis and other minor channel work and bank protection that has been accomplished by the U.S. Soil Conservation Service and other agencies. Lewis County is carrying out some channel realignment on Salzer Creek from River Mile 0.9 to River Mile 1.15. This project was not considered in this study.

The U.S. Army Corps of Engineers, Seattle District, is engaged in an ongoing study of flood damage reduction measures in the Centralia-Chehalis area which includes a system of levees along the Chehalis and Newaukum Rivers (Reference 14). Implementation of any measure arising from this study is not expected to take place before 1984.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual occurrence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each stream studied in detail in the community.

The discharges are based on the results of hydrologic analyses employing three analytical methods. Statistical log-Pearson Type III analyses, as specified by the U.S. Water Resources Council (Reference 15), were carried out on streamflow data obtained from records of 10 gaging stations operated by the U.S. Geological Survey within the Chehalis River basin. The gaging stations, their locations, and periods of record are listed in Table 3.

Table 3. Stream Gages Within the Chehalis River Basin

Stream and Gage Number	Location	Period of Record
Chehalis River Near Grand Mound, Washington (No. 120275)	River Mile 59.9	1928-Present
Skookumchuck River Near Centralia, Washington (No. 1202615)	River Mile 20.7	1939-Present
Near Bucoda, Washington (No. 120264)	River Mile 6.4	1967-Present
Near Vail, Washington (No. 120257)	River Mile 28.8	1967-Present
Chehalis River Near Doty, Washington (No. 120200)	River Mile 101.8	1939-Present
South Fork Chehalis River Near Boistfort, Washington (No. 120209)	10 Miles Southeast of Boistfort, Washington	1965-Present
Newaukum River Near Chehalis, Washington (No. 120250)	River Mile 4.4	1942-Present
North Fork Newaukum River Near Forest, Washington (No. 120245)	River Mile 6.6	1957-1966
South Fork Newaukum River Near Onalaska, Washington (No. 120240)	River Mile 22.8	1958-Present
Elk Creek Near Doty, Washington (No. 120205)	River Mile 2.5	1944-Present

A regional flood-frequency analysis was carried out based on statistical data derived from the gage records. Basin parameters correlated in the multiple regression equations included drainage area, precipitation, and time of concentration. Residuals, or regression constants, were computed and plotted, and isopleths were drawn on regional maps. Methodology for this analysis was taken from Statistical Methods in Hydrology (Reference 16).

Rainfall-runoff relationships were developed using synthetic hydrograph methodology and a computerized runoff-routing model developed by Tudor Engineering Company. Utilizing the U.S. Soil Conservation Service synthetic hydrograph criteria (Reference 17), hydrographs representing the design recurrence floods were generated and routed throughout the study reach. Precipitation volumes were obtained from the National Oceanic and Atmospheric Administration Precipitation-Frequency Atlas (Reference 18), and intensity distributions were based on rainfall records at Centralia, Chehalis, and Cinebar.

Peak discharge-drainage area relationships for Chehalis River, Newaukum River, Coal Creek, Salzer Creek, and Dillenbaugh Creek are shown in Table 4.

Table 4. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10-Year	50-Year	100-Year	500-Year
Chehalis River Downstream of Confluence with Newaukum River	593	32,100	42,000	46,450	58,700
Newaukum River At Confluence With Chehalis River	155.0	7,580	10,060	10,880	13,350
Coal Creek At Confluence With **Salzer Creek**	9.2	230	420	530	790
Salzer Creek At Confluence With Chehalis River	24.5	600	1,070	1,360	--[1]
Dillenbaugh Creek At Confluence With Chehalis River	12.1	440	560	630	800

[1]Data Not Available

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of streams in the community were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each stream studied in the community.

Water-surface elevations for the entire Chehalis River and for Newaukum River from its mouth to the Interstate Highway 5 bridge were computed using the U.S. Army Corps of Engineers' computerized hydraulic model. The model was modified to reflect changes in design flood discharges.

Elevations for Dillenbaugh Creek and the Newaukum River upstream of Interstate Highway 5 were computed using the U.S. Army Corps of Engineers HEC-2 computer program (Reference 19).

Elevations for Salzer and Coal Creeks were obtained directly from a report entitled Flood Hazard Analysis of Salzer and Coal Creeks, Lewis County, Washington, performed by the U.S. Soil Conservation Service (Reference 20).

Streambed cross sections and bridges were field surveyed on Dillenbaugh Creek. Cross sections for the Chehalis River and for the Newaukum River downstream of Interstate Highway 5 were taken from a U.S. Army Corps of Engineers study on the two rivers (Reference 11). Cross sections for Salzer and Coal Creeks were taken from the U.S. Soil Conservation Service study on the two creeks (Reference 20).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Roughness coefficients (Manning's "n") varied for the streams as follows:

	Manning's "n"	
Stream	Channel	Overbank
Chehalis River	0.035-0.050	0.050-0.150
Newaukum River	0.035-0.050	0.080-0.100
Coal Creek	0.030-0.050	0.100-0.150
Salzer Creek	0.035-0.045	0.150
Dillenbaugh Creek	0.040-0.050	0.100-0.200

Starting water-surface elevations for the Chehalis and Newaukum Rivers and Salzer and Coal Creeks were taken directly from the two studies concerning these areas (References 11 and 20, respectively). Starting water-surface elevations for Dillenbaugh Creek were obtained from confluence elevations with the Chehalis River.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

No 500-year elevations were provided by the U.S. Soil Conservation Service for Salzer Creek; therefore, no 500-year profile is shown.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

A prime purpose of the National Flood Insurance Program is to encourage State and local governments to adopt sound flood plain management programs. Each Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Insurance Administration as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were either interpolated using topographic maps at a scale of 1:2400, with contour intervals of 2 and 5 feet (References 21, 22, and 23), and at a scale of 1:4800, with a contour interval of 4 feet (Reference 24), or developed photogrammetrically using aerial photographs at a scale of 1:12,000.

In cases where the 100- and 500-year flood boundaries are close together, only the 100-year flood boundary has been shown.

Flood boundaries for the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2).

Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity and increases flood heights, thus increasing flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment in order that the 100-year flood be carried without substantial increases in flood heights. As minimum standards, the Federal Insurance Administration limits such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced.

The floodways developed in this study were computed on the basis of equal conveyance reduction from each side of the flood plain.

The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 5).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood boundaries are close together, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 4.

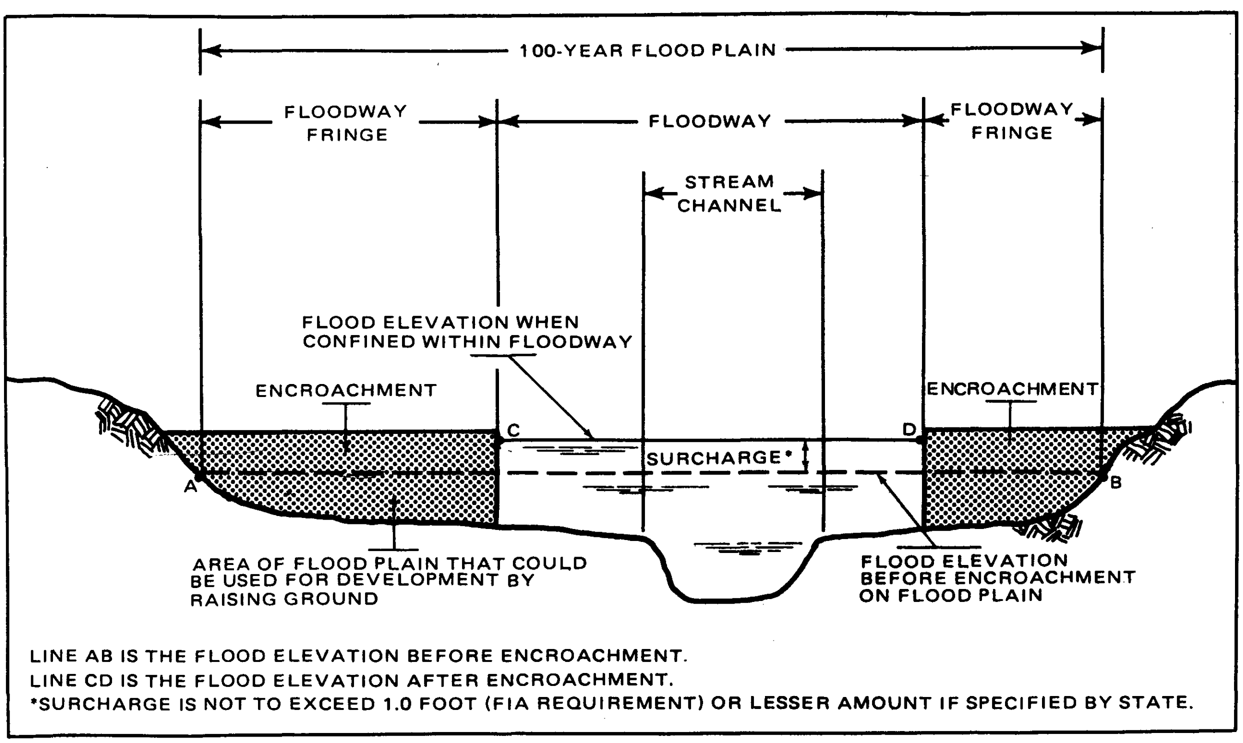


Figure 4. Floodway Schematic

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE
Chehalis River								
A	72.66	2,233/680[3]	21,919	2.1	177.4	177.4	178.3	0.9
B	74.02	3,291/1910[3]	25,949	1.5	178.8	178.8	179.7	0.9
C	74.73	698/415[3]	8,953	5.2	179.8	179.8	180.6	0.8
D	75.17	1,901/565[3]	10,572	4.4	181.4	181.4	182.1	0.7
Newaukum River								
A	0.10	325[2]	4,820	2.3	181.7	180.6[4]	180.6[4]	0.0
B	0.54	650[2]	7,240	1.9	181.7	182.4[4]	182.4[4]	0.0
C	1.03	980[2]	7,856	1.4	183.2	183.2	184.2	1.0
D	1.68	210[2]	2,063	3.7	184.1	184.1	185.1	1.0
E	1.84	1,464	9,427	1.2	184.9	184.9	185.6	0.7

[1] Miles Above Mouth [2] Floodway Lies Entirely Outside Corporate Limits [3] Width/Width Within Corporate Limits [4] Elevations Computed Without Consideration of Backwater From the Chehalis River

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF CHEHALIS, WA
(LEWIS CO.)

FLOODWAY DATA

CHEHALIS RIVER-NEWAUKUM RIVER

TABLE 5

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Coal Creek								
A	0.00	165	--[2]	--[2]	175.5	175.5	176.5	1.0
B	1.17	265	--[2]	--[2]	177.1	177.1	178.1	1.0
C	1.36	70	--[2]	--[2]	178.1	178.1	179.1	1.0
Salzer Creek								
A	0.90	50	--[2]	--[2]	175.5	175.5	176.5	1.0
B	1.50	270/192[3]	--[2]	--[2]	175.5	175.5	176.5	1.0

[1]Miles Above Mouth [2]Data Not Provided in U.S. Soil Conservation Service Report [3]Width/Width Within Corporate Limits

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF CHEHALIS, WA
(LEWIS CO.)

FLOODWAY DATA

COAL CREEK-SALZER CREEK

TABLE 5

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE
Dillenbaugh Creek								
A	0.43	95	279	2.3	179.9	174.4[2]	175.4[2]	1.0
B	0.58	191	808	0.7	179.9	174.9[2]	175.9[2]	1.0
C	0.81	480	2,797	0.2	181.0	175.0[3]	176.0[3]	1.0
D	1.08	150	546	1.0	183.0	175.3[3]	176.3[3]	1.0
E	1.44	190	892	0.6	184.2	176.6[3]	177.5[3]	0.9
F	1.74	180	464	1.2	184.5	177.5[3]	178.3[3]	0.8
G	1.86	16	127	4.2	184.8	178.3[3]	179.1[3]	0.8
H	1.90	250/165[4]	856	0.6	184.9	179.2[3]	179.9[3]	0.7
I	2.52	51[5]	166	3.2	186.2	180.5[3]	181.3[3]	0.8

[1] Miles Above Confluence With Chehalis River [2] Elevations Computed Without Consideration of Backwater Effects from Chehalis River [3] Elevations Computed Without Consideration of Influence of Newaukum River [4] Width/Width Within Corporate Limits [5] Entire Floodway Lies Outside Corporate Limits

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF CHEHALIS, WA
(LEWIS CO.)

FLOODWAY DATA

DILLENBAUGH CREEK

TABLE 5

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the Federal Insurance Administration has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting the City of Chehalis.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of reaches determined for the flooding sources of the City of Chehalis are shown on the Flood Profiles (Exhibit 1) and summarized in Table 6.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is the Federal Insurance Administration device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (FEET NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Chehalis River							
Reach 1	0001	-2.9	-0.8	1.9	030	A6	Varies - See Map
Reach 2	0001,0002	-2.2	-0.6	1.8	020	A4	Varies - See Map
Newaukum River							
Reach 1	0002	-3.0	-0.9	2.4	030	A6	Varies - See Map
Coal Creek							
Reach 1	0001	-4.5	-1.6	3.1	045	A9	Varies - See Map
Dillenbaugh Creek							
Reach 1	0001,0002	-3.0	-0.9	2.4	030	A6	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

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Federal Insurance Administration

CITY OF CHEHALIS, WA
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FLOOD INSURANCE ZONE DATA

CHEHALIS RIVER-NEWAUKUM RIVER-COAL CREEK-DILLENBAUGH CREEK

TABLE 6

5.3 Flood Insurance Zones

After the determination of reaches and their respective Flood Hazard Factors, the entire incorporated area of the City of Chehalis was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zones A4, A6, and A9:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to Flood Hazard Factors.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

The flood elevation differences, Flood Hazard Factors, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are summarized in Table 6.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Chehalis is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the Federal Insurance Administration.

6.0 OTHER STUDIES

The U.S. Army Corps of Engineers, Seattle District, published the results of a special study for the Chehalis and Newaukum Rivers in the vicinity of Chehalis, carried out in 1968 and updated in 1974 and 1976 (Reference 11). This Flood Insurance Study agrees exactly with that study.

The U.S. Soil Conservation Service published a Flood Hazard Analysis for Salzer and Coal Creeks in May 1975 (Reference 20). The data and results of these reports were reviewed and are incorporated into this study. This Flood Insurance Study agrees exactly with that study.

This study generally agrees with the flooding shown on the Flood Hazard Boundary Map prepared by the Federal Insurance Administration (Reference 25). However, because this study is detailed, it supersedes that map.

This study is authoritative for the purposes of the National Flood Insurance Program; data presented herein either supersede or are compatible with all previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Federal Insurance Administration, Regional Director, Insurance and Mitigation Division, Federal Regional Center, Bothell, Washington 98011.

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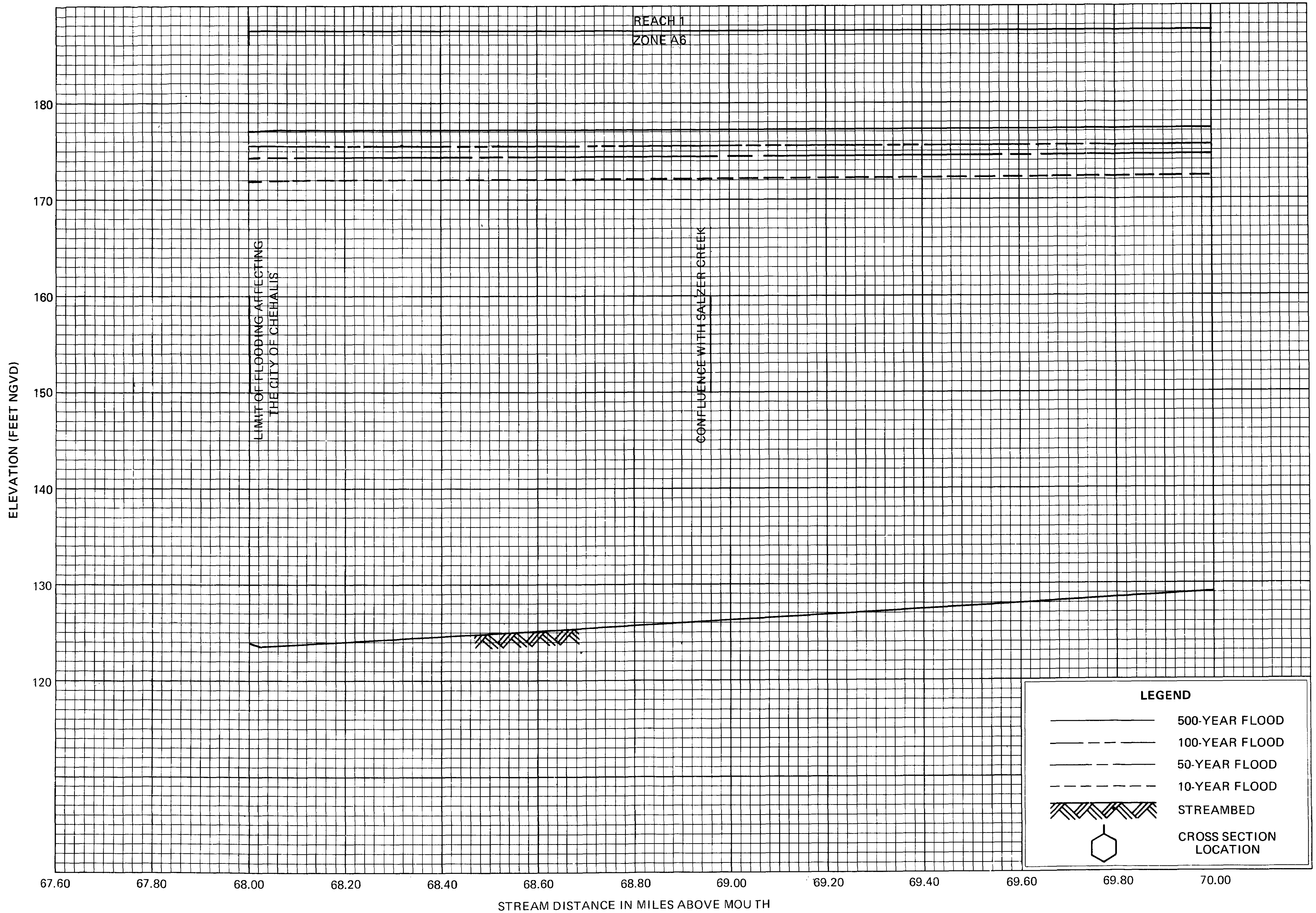


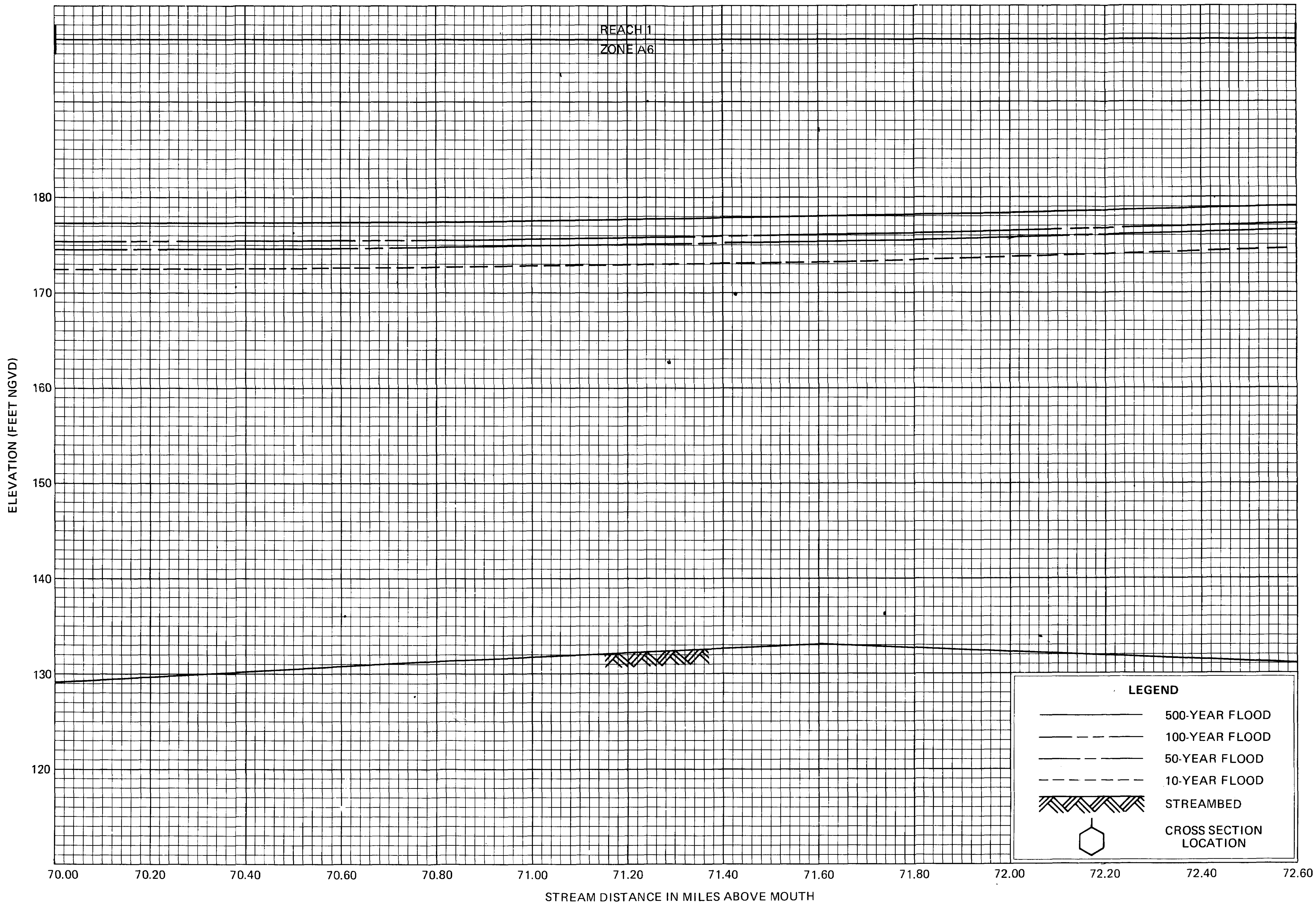
FLOOD PROFILES

CHEHALIS RIVER

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

CITY OF CHEHALIS, WA
(LEWIS CO.)

01P



FLOOD PROFILES

CHEHALIS RIVER

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Federal Insurance Administration

CITY OF CHEHALIS, WA
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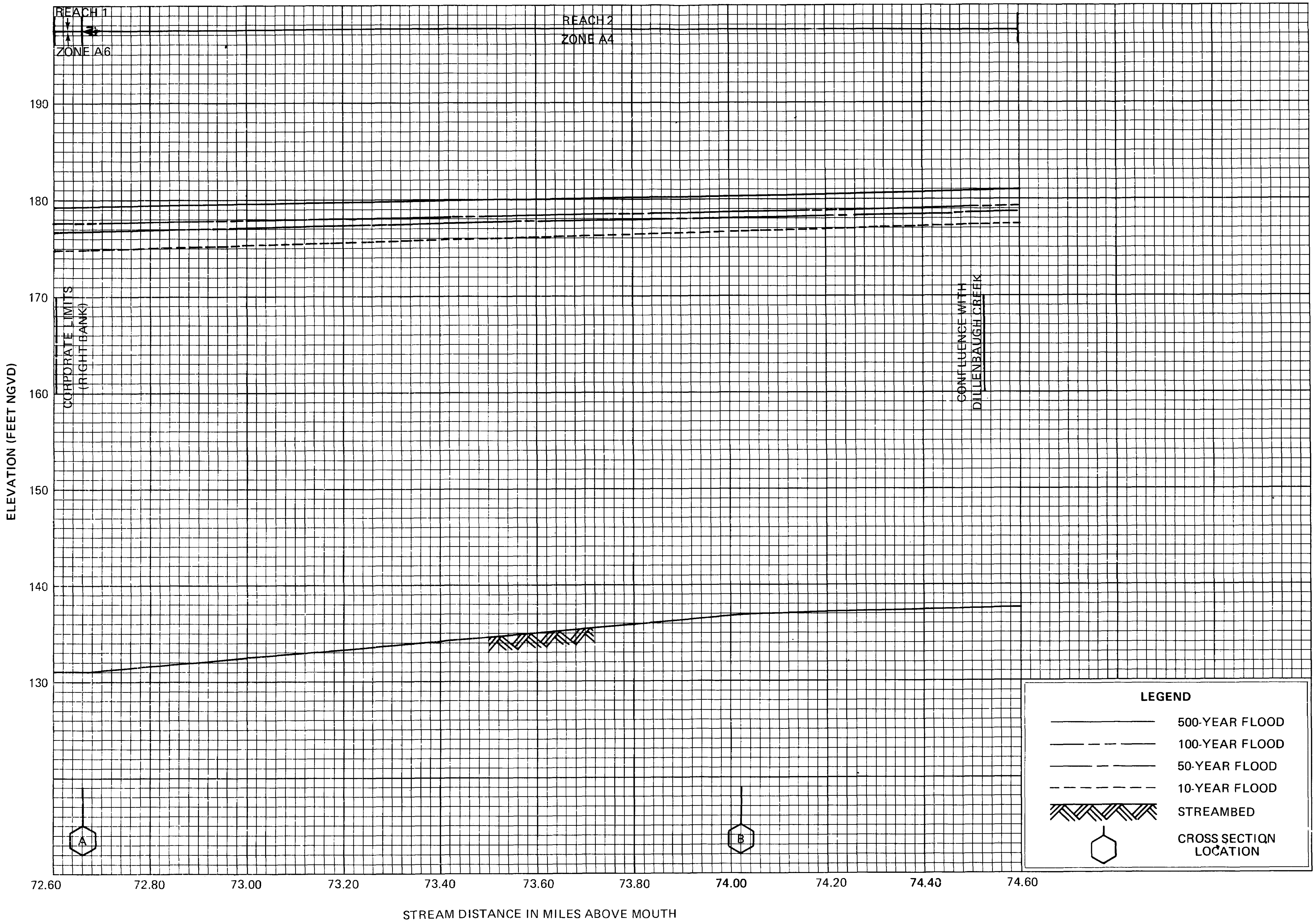
02P



FLOOD PROFILES

CHEHALIS RIVER

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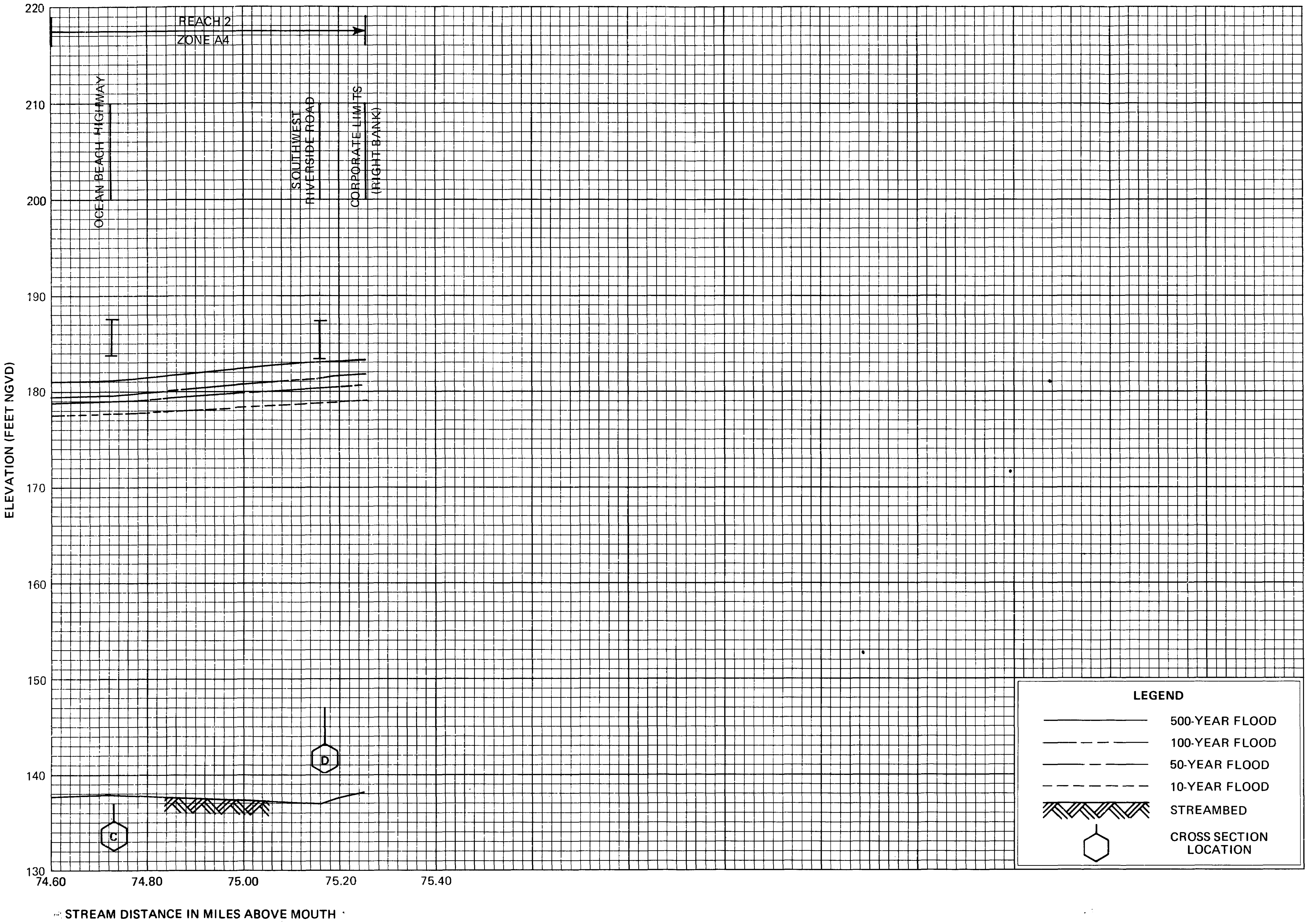

FLOOD PROFILES

CHEHALIS RIVER

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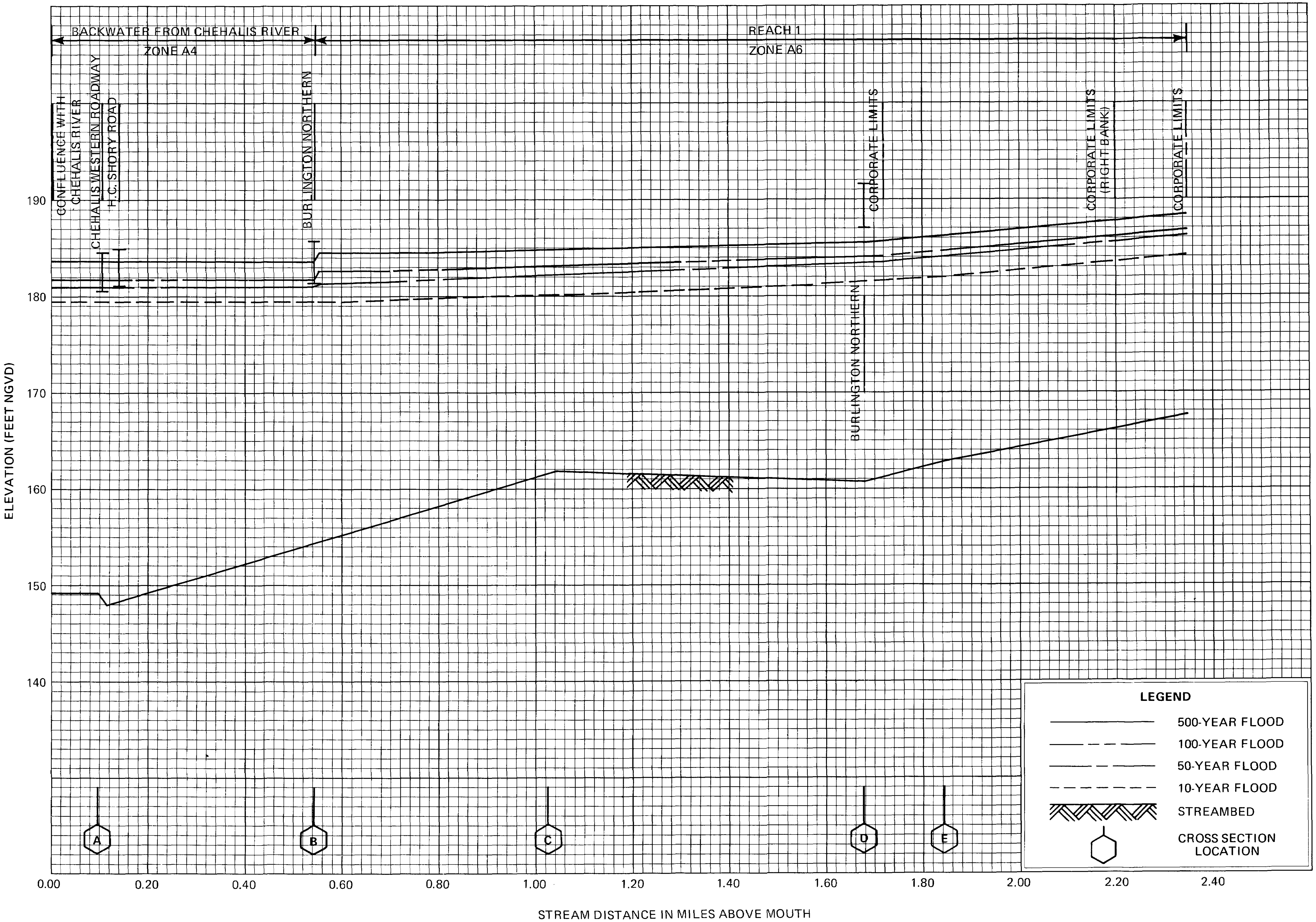

FLOOD PROFILES

NEWAUKUM RIVER

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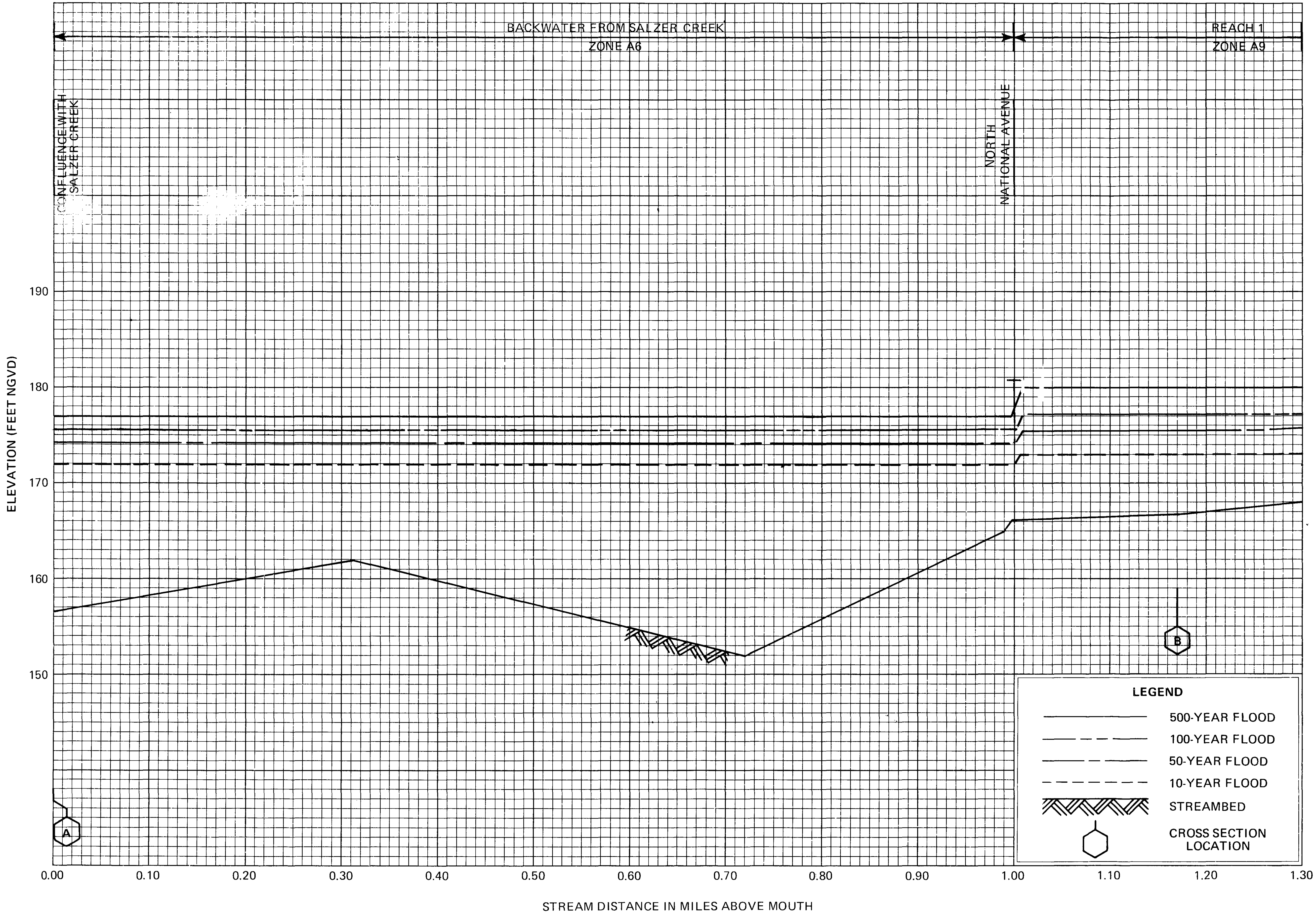
05P



FLOOD PROFILES

COAL CREEK

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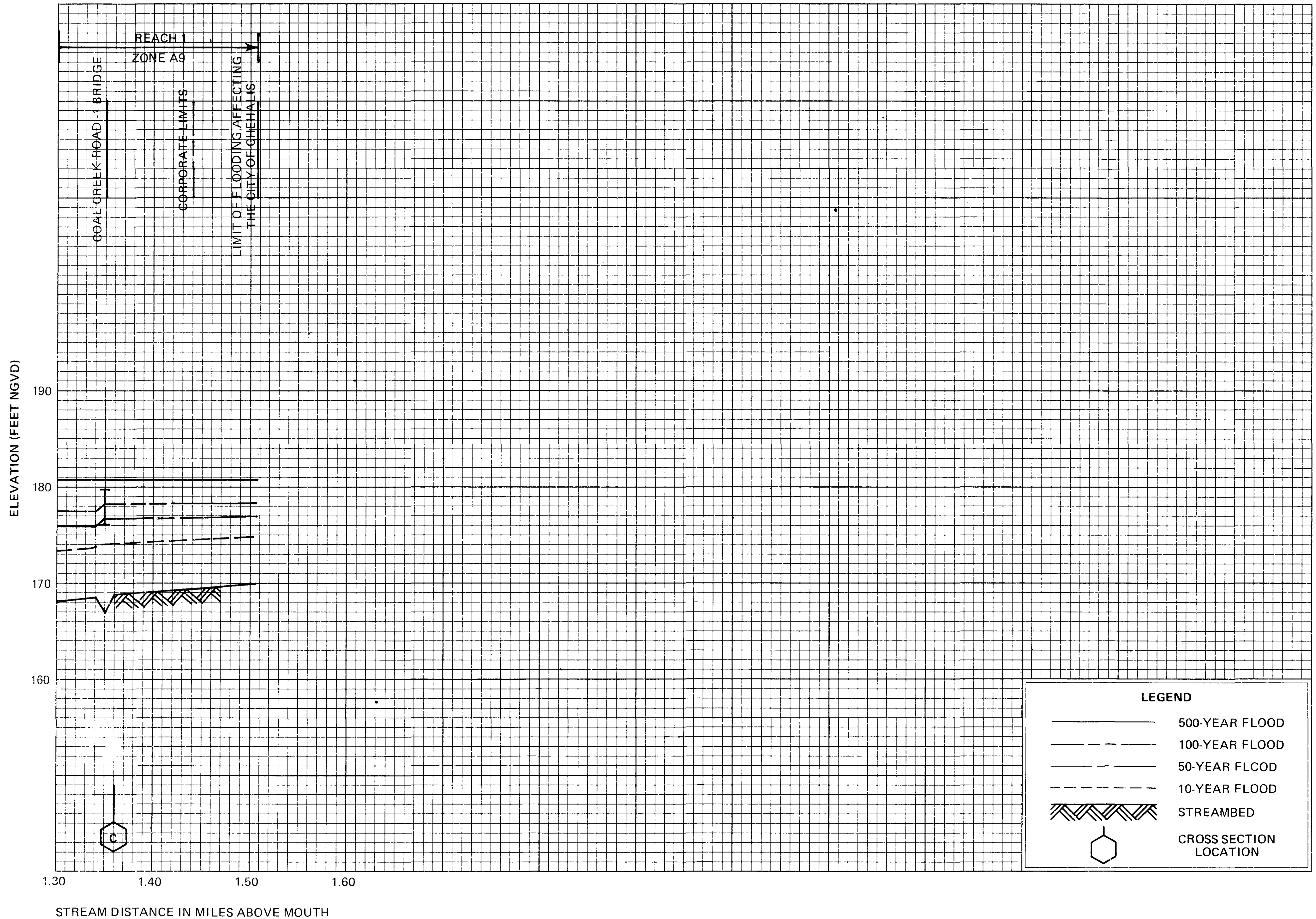
06P



FLOOD PROFILES

COAL CREEK

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CITY OF CHEHALIS, WA
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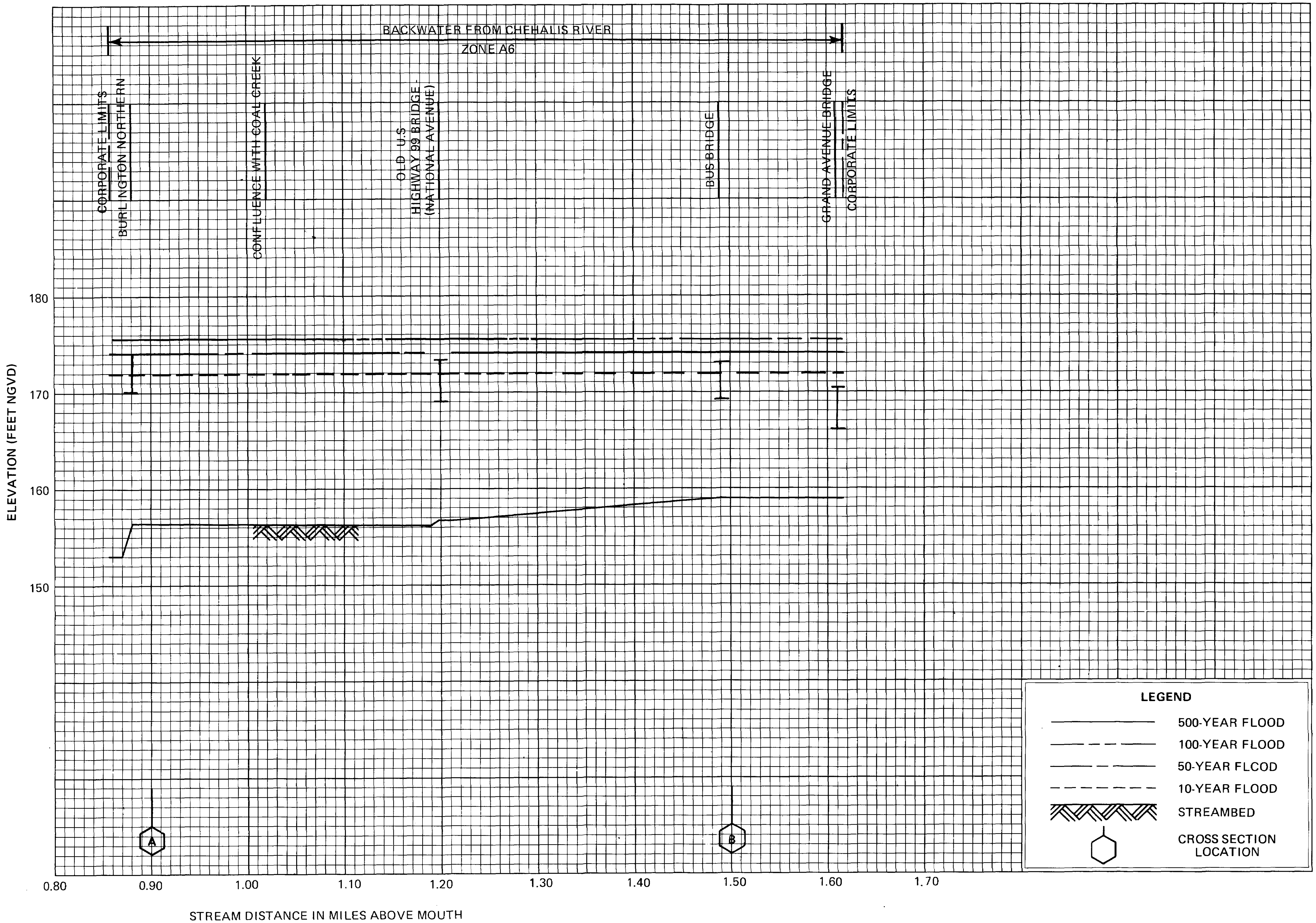

FLOOD PROFILES

SALZER CREEK

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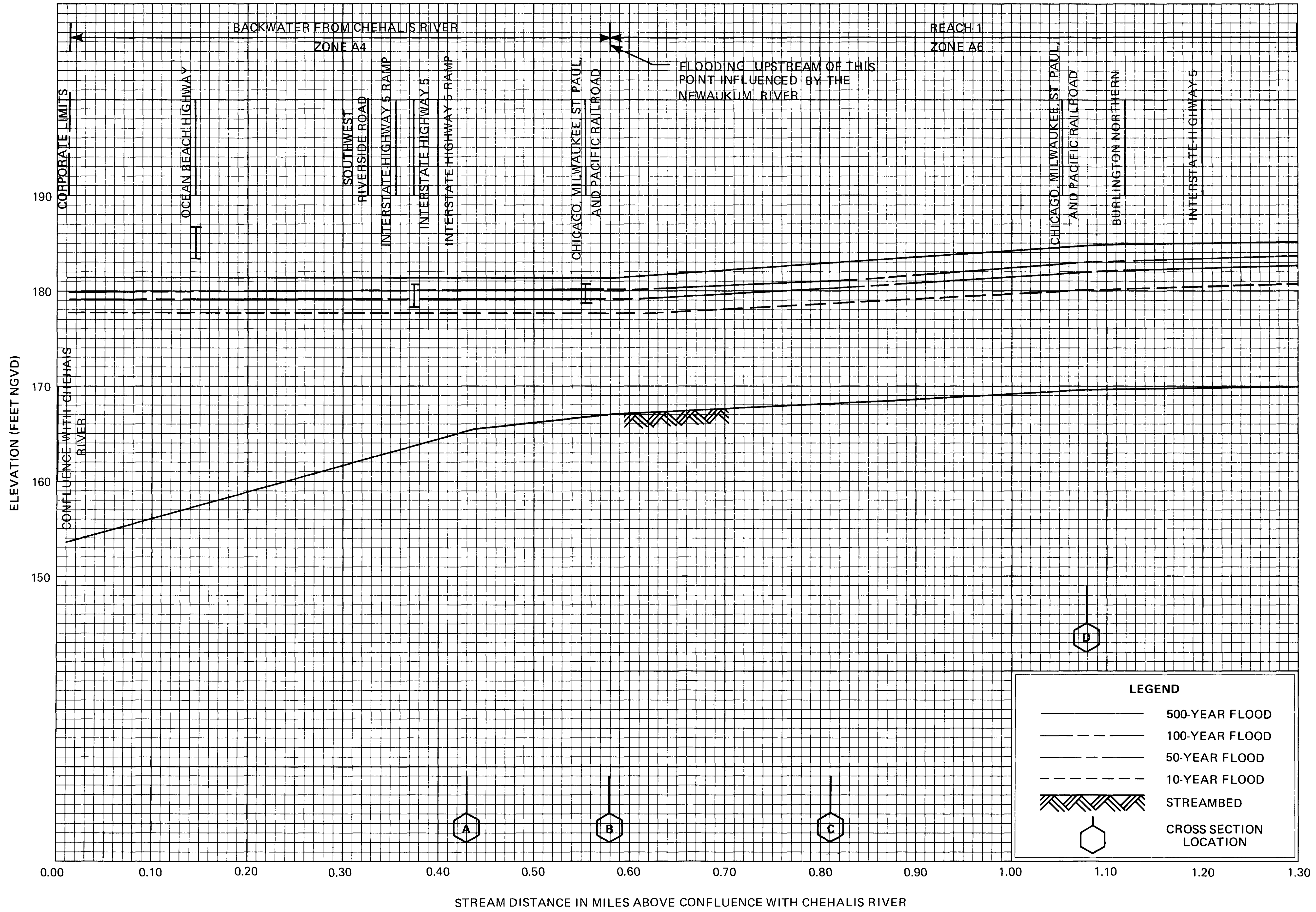

FLOOD PROFILES

DILLENBAUGH CREEK

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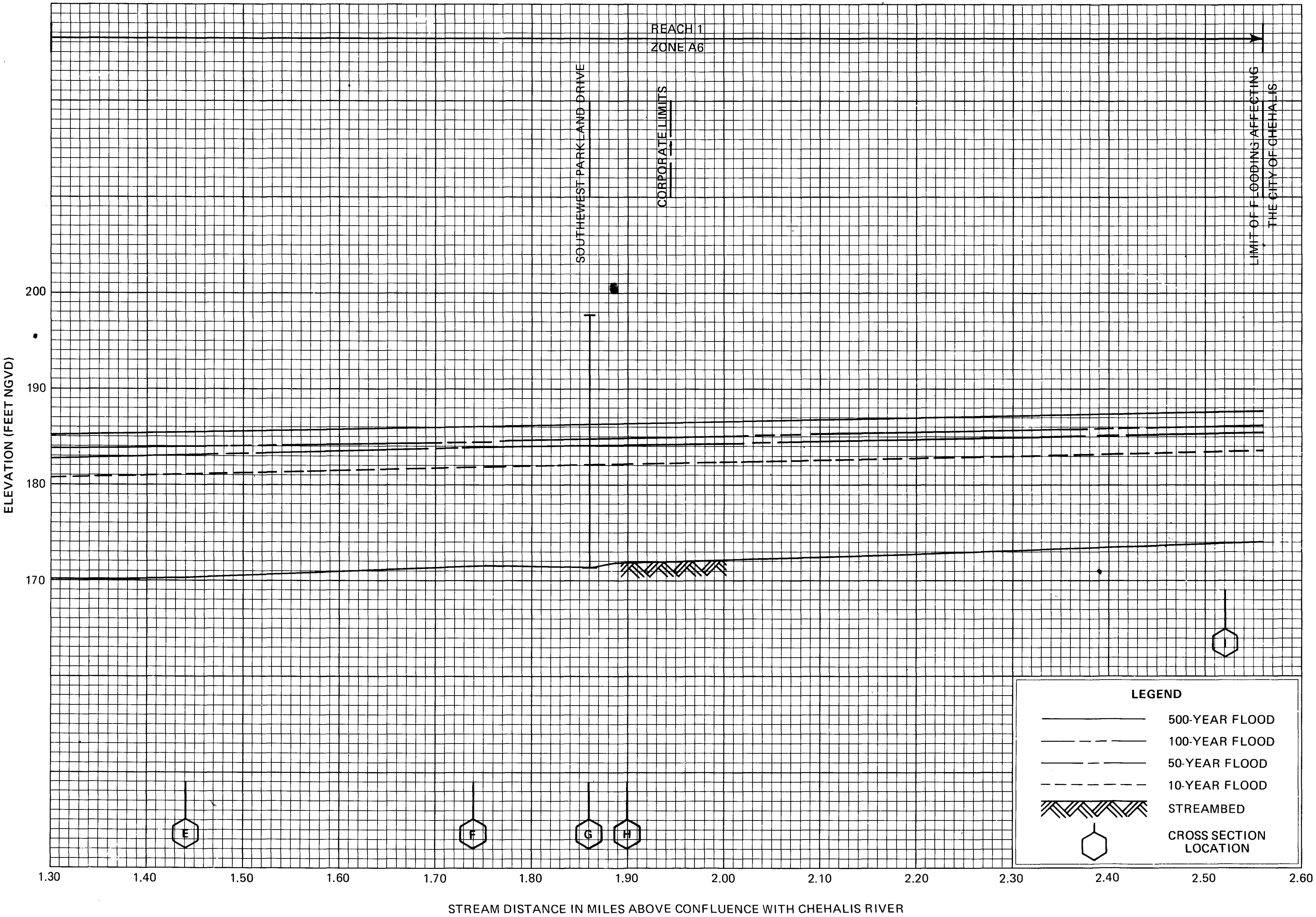

FLOOD PROFILES

DILLENBAUGH CREEK

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